

Severe Weather Awareness in the Western Carolinas and Northeast Georgia



National Weather Service, Greenville-Spartanburg, SC

Severe Thunderstorms

What is a thunderstorm? This potentially complicated question can be answered in several ways, the most obvious being that it's simply a "cloud that produces lightning." A more descriptive, but equally simple definition is that a thunderstorm is "hot air going up." A warm and humid (i.e., unstable) atmosphere is required for thunderstorm development. This is why spring and summer are the favored time of year for thunderstorms. If some atmospheric process forces the unstable air upward, the air will rise and cool until it saturates, causing a cloud to form. This rising air is called an "updraft." As long as the updraft remains warmer than the surrounding environment, it will continue to rise, causing the cloud to grow vertically. On a typical day in the warm season, once a cloud grows to 20,000 to 30,000 feet, it will begin to produce heavy rain and lightning. The falling rain causes a "downdraft," or sinking column of air to form. Therefore, a thunderstorm consists of two primary air currents: an updraft and a downdraft. The



Fig. 1. A "shelf cloud," representing the leading edge of air spreading horizontally away from a thunderstorm downdraft. Wind gusts of 60 mph or more would likely be experienced along the leading edge and just to the rear of this cloud formation.

updraft takes the warm, humid air into the atmosphere; rain in the downdraft brings cooler temperatures to the surface, thereby "stabilizing" the atmosphere.

A thunderstorm may eventually grow to a height of 50,000 feet or more before it stops developing. Generally speaking, the "taller" the storm, the more likely it is to produce violent weather.

Thunderstorms are characterized in two ways: general and severe. A Severe thunderstorm is one that produces large hail (i.e., one-inch diameter or larger), damaging wind gusts, and/or tornadoes.

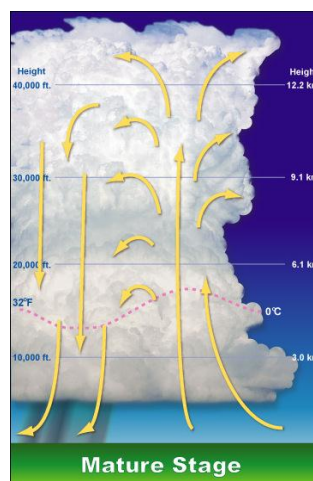


Fig. 2. Schematic of a mature thunderstorm, depicting the updraft (yellow arrows pointing toward top of the page) and the downdraft.

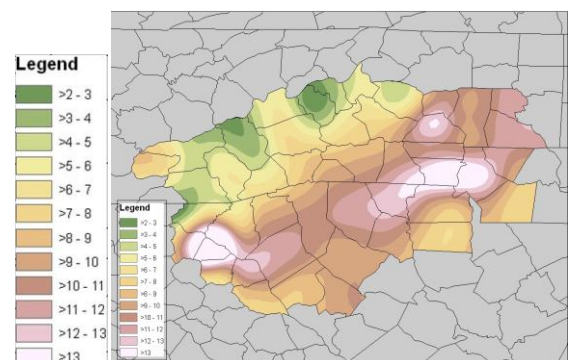


Fig. 3. A map depicting the average number of days during a 5-year period with a severe thunderstorm wind gust within 200 square miles of any point.

Here in the Western Carolinas, we receive our fair share of thunderstorms. This is due to our proximity to the Gulf of Mexico and the Atlantic Ocean, which provide two sources of warm, humid air in the warm season. The mountains also play a role in our thunderstorm frequency, as air flowing around and up mountain slopes can provide the lift that is required to push the unstable air up into the atmosphere. On days when the atmosphere is particularly unstable, some thunderstorms may become severe.

Damaging wind gusts are the most common form of severe weather across the western Carolinas and northeast Georgia. Damaging wind gusts, often called “downbursts,” form in association with the downdraft. They are caused when sinking air within the downdraft accelerates toward the surface, then spreads horizontally away from the storm after impacting the ground. Although most downbursts cause wind gusts of around 60 mph, speeds of 100 mph or more are possible. Wind gusts of this magnitude can cause extensive damage to trees, power lines, and manufactured homes. This is equivalent to the wind speeds produced by weak tornadoes. This is a very important point: downbursts can produce damage similar to a weak or even moderately strong tornado. The peak time of year for downbursts across the region is June and July. They are especially common in the piedmont. A typical piedmont county experiences at least one event on four to seven days per year.



Fig. 4. Although the damage in these photos may appear to be the result of a tornado, it was actually caused by downbursts. Downbursts can produce damage similar to a tornado, and are quite common across the western Carolinas and northeast Georgia. This is why severe thunderstorm warnings should be heeded.

The second most common form of severe weather across the Carolinas and northeast Georgia is large hail. Hail is simply ice that develops in the upper levels of a tall thunderstorm, where temperatures are well below freezing. The

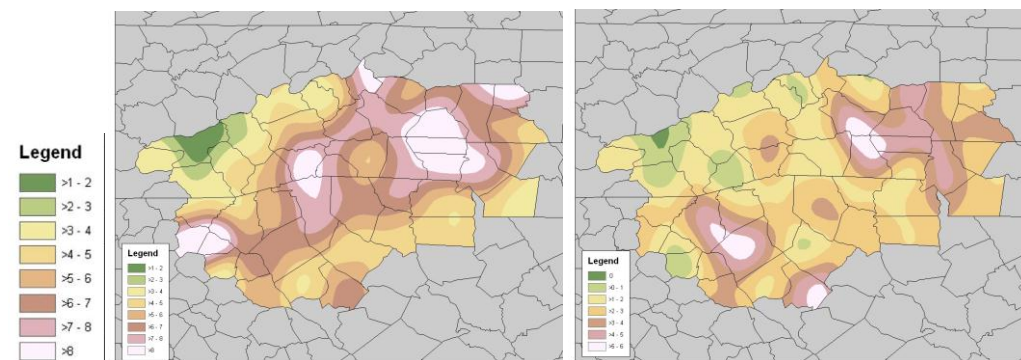


Fig. 5. (Left) Same as in Fig. 3 except for large hail. (Right) The number of days with hail the size of a golf ball or larger within 200 square miles of any point from 1995 to 2008.

strong updrafts associated with such storms suspend ice particles aloft within the storm's core. These suspended hailstones are subject to collisions with other ice particles. These collisions cause the hailstones

to grow. Eventually, the hail will become too large and heavy for the updraft to support, allowing the hail to fall to the ground via the downdraft. Large hailstones across the western Carolinas and northeast Georgia rarely exceed the size of a quarter. However, hail as large as softballs has been reported across the area as recently as 2011.

In this region, large hail is most common in the piedmont of the western Carolinas, where two to four days of large

Severe Thunderstorm Safety

hail are observed in a given year. Hail that is the size of a golf ball or larger is quite rare, but is observed on about one day per year across the piedmont. The peak time of year for large hail is May and June.

The main severe weather threat in the western Carolinas and northeast Georgia is damaging thunderstorm winds. Remember that downbursts can produce wind speeds and damage similar to a tornado. For this reason, it is important to take National Weather Service warnings for severe thunderstorms seriously. Perhaps the greatest hazard associated with downbursts in this region is that of trees falling on automobiles and structures. Over the past 10 years, there have been 7 deaths associated with thunderstorm winds across the western Carolinas and northeast Georgia, each fatality being the result of a falling tree. Most of the monetary structural damage associated with downbursts in this area is from falling trees. Dead and diseased trees are especially susceptible to being downed by severe thunderstorm winds. You should strongly consider having these trees removed from your property, especially if they are located on the west side of your home.



Fig. 6. One of the greatest dangers associated with downbursts in the western Carolinas and northeast Georgia is from falling trees. Every year, falling trees result in millions of dollars in damage to property across the region. Injuries and even fatalities also occur from time to time.



Fig. 7. Damage to a manufactured home by large hail up to the size of baseballs. Large hail is responsible for billions of dollars in property losses across the United States each year. The damage in this photo occurred on March 15, 2008 near Callison, SC. Photo courtesy of Greenwood County Emergency Management.

The safest place to be during a severe thunderstorm is on the lowest level of a well-constructed building, in an interior room. Avoid any rooms that may be damaged by falling trees.

If you are in an automobile, the safest course of action is to abandon it for sturdy shelter. If shelter is not available, you should attempt to seek out an open area, away from trees and power lines. If strong winds develop, try to turn your vehicle so that your back is to the wind. The strong wind will typically be from the west or northwest.



Fig. 8. Baseball size hail. Hail of this size is rare, but occurs once every couple of years across the area.

If you live in a manufactured home, you should strongly consider leaving the home for nearby sturdier shelter if the home is not securely tied down.

Large hail is mainly a threat to crops and property, rarely causing deaths or even significant injuries to people. However, crop and

property damage losses number in the billions of dollars across the country during a typical year. You should always seek shelter indoors during a hailstorm, as injuries from very large and/or wind-driven hail can occur. Although your first priority should always be the safety of you and your family during a severe thunderstorm, you should attempt to move valuable property under cover prior to the arrival of a hailstorm.

Table 1. Reports of hail larger than baseball size across the western Carolinas and northeast Georgia since 1986.

County	Nearest City	Date	Max Hail Size
Davie, NC	Mocksville	June 4, 1993	Grapefruit
Cabarrus/Rowan, NC	Kannapolis	May 7, 1998	Softball
Catawba, NC	Newton	June 3, 1998	Softball
Spartanburg, SC	Spartanburg	August 20, 1999	Grapefruit
Burke, NC	Morganton	May 24, 2000	Softball
Oconee, SC	Westminster	April 28, 2002	Teacup
Abbeville, SC	Calhoun Falls	May 6, 2003	Grapefruit
Anderson, SC	Iva	March 15, 2008	Grapefruit
York, SC	Clover	April 9, 2011	Softball
Greenville, SC	Tigerville	May 10, 2011	Teacup

Tornadoes

Tornadoes are violent rotary winds that descend from severe thunderstorms. They produce the most violent winds found in nature. In their strongest form, tornadoes are capable of producing wind speeds in excess of 200 mph! The highest recorded wind speed associated with a tornado was on May 3, 1999, near Moore, OK, when a portable Doppler radar measured a wind speed of 318 mph at a height of about 250 feet above the ground. Tornadoes of this magnitude produce devastating damage, causing total destruction to everything in their path. Fortunately, tornadoes that occur across the United States each year.

As is the case with hurricanes, tornadoes are assigned a rating. However, because tornadoes develop rapidly, and because they are very

Table 2. The Enhanced Fujita scale.

EF Rating	Estimated Wind Speed (mph)
EF0	65 to 85
EF1	86 to 110
EF2	111 to 135
EF3	136 to 165
EF4	166 to 199
EF5	200+



Fig 9. A large EF5 tornado moves through Tuscaloosa, AL on April 27, 2011. This tornado was the most devastating of an historic outbreak of tornadoes that resulted in 313 fatalities and thousands of injuries across the Tennessee Valley and southern Appalachians region on the 27th and 28th. The powerful supercell thunderstorm that produced the Tuscaloosa tornado was also responsible for a late-evening EF3 tornado in northeast Georgia that destroyed multiple homes and killed one person on Lake Burton in Rabun County. If the storm system responsible for these tornadoes had been several hours slower, multiple devastating tornadoes would have likely occurred across the western Carolinas and northeast Georgia. Image courtesy of Associated Press.

small, measuring their wind speeds in real time is practically impossible. Therefore, tornadoes are rated by National Weather Service meteorologists after the fact based upon the type of damage that they produce. The rating system used to classify tornadoes is called the Enhanced Fujita Scale (EF-scale). Within the EF-scale, tornadoes can be further classified into weak (EF0 and EF1), strong (EF2 and EF3), and violent (EF4 and EF5). In the western Carolinas and northeast Georgia, weak tornadoes make up just under 80% of the approximately 12 tornadoes that occur across the area in a

the area since 1950 were classified as violent. No EF5 tornado has ever been documented in the states of Georgia, North Carolina, and South Carolina.

Although they account for only 1–2 percent of all tornadoes, violent tornadoes are responsible for 70% of the 62 fatalities associated with tornadoes that occur across the United States in a

typical year. This trend also holds true in the western Carolinas and northeast Georgia, where 64% of tornado-related deaths that have occurred since 1950 have been the result of F4 tornadoes.

Tornadoes in this area are most common in the piedmont. On average, piedmont counties experience a tornado once every two or three years. Due to the rugged terrain across the mountains, tornadoes are extremely rare, generally occurring only once in a decade. Peak tornado season is March through May. Roughly half of the tornadoes that touch down across the area occur during this three-month period. However, tornadoes have been reported in every month, with October, December, and January being the least active months. Similar to other severe weather threats, late afternoon through early evening are the favored time of day for tornadoes.

Strong and violent tornadoes occur across piedmont counties about once every 10 years on average. Meanwhile, strong and violent tornadoes are almost unheard of across the mountains, with only a handful of mountain counties reporting the occurrence of an EF2 or stronger tornado since 1950. However, the April 27, 2011 EF3 tornado that devastated the Lake Burton area in Rabun County, GA serves as a reminder that mountainous areas are not immune to strong tornadoes.

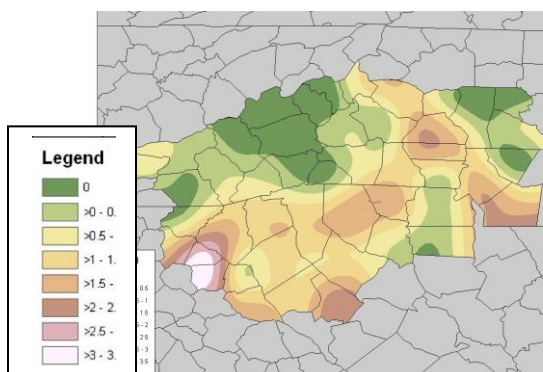


Fig. 11. The number of days from 1950 to 2008 with an EF2 or stronger tornado within 200 square miles of any point.

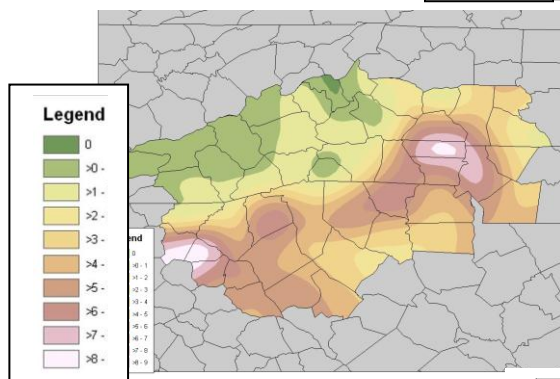


Fig. 10. The number of days from 1950 to 2008 with a tornado within 200 square miles of any point across the western Carolinas and northeast Georgia.

typical year. This means that the vast majority of the tornadoes that occur across the area each year produce wind speeds of around 100 mph or less, not much stronger than typical downburst winds. Meanwhile, strong tornadoes account for about 20% of the total, while only 2% of the tornadoes that have occurred across

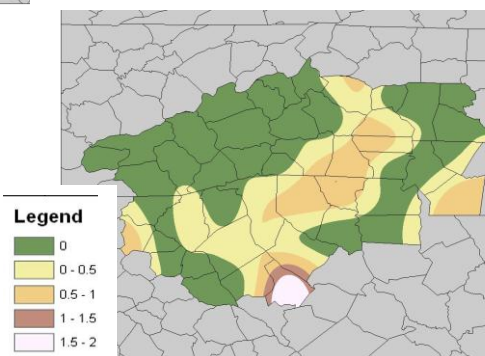


Fig. 12. The number of days from 1950 to 2008 with an EF3 or stronger tornado within 200 square miles of any point across the western Carolinas and northeast Georgia.

Tornado Safety

Although strong and violent tornadoes are rare across the western Carolinas and northeast Georgia, they have occurred in the past, and they will occur again. Remember, even weak tornadoes can flip automobiles, severely damage, or even destroy manufactured homes, and uproot or snap off large trees. You should respond identically to all tornado warnings issued by the National Weather Service. In most cases, meteorologists are unable to accurately predict tornado intensity. You should therefore react as if any approaching tornado is “the big one.”

In order to adequately prepare for a potential tornado, you should have a preset plan of action. If a tornado warning is issued, you and the members of your family or your employees should know exactly where to go and what to do. Even the most timely tornado warnings may only provide 10–15 minutes of lead time. This is not adequate time, nor is it the proper time to decide what you should do.

The safest place to be during a tornado is in an underground shelter, including a basement. If such a shelter is not available, seek out an interior room on the lowest level of a well-constructed home or office building away from windows and doors. This may be an interior bathroom or a closet. Your goal should be to place as many walls and floors between you and the outside as



Fig. 13. An EF2 tornado approaches the city of Franklin Springs, GA on September 16, 2004. The tornado inflicted more than a million dollars in damage to the downtown area of Franklin Springs and killed one person. Photographer unknown.

Table 3. F3/EF3 and stronger tornadoes reported in the western Carolinas and northeast Georgia since 1950.

County(s) Affected	Rating	Date	Time (LST)
Greenville, SC /Spartanburg, SC	F3	May 10, 1952	1400
Abbeville, SC/Greenwood, SC	F4	March 31, 1973	1820
Greenville, SC/Spartanburg, SC/ Cherokee, SC/Cleveland, NC	F3	May 27, 1973	1720
Laurens, SC	F3	December 13, 1973	1353
Greenwood, SC	F4	December 13, 1973	1430
Anderson, SC	F3	April 8, 1974	1533
Spartanburg, SC/Cherokee, SC/ Rutherford, NC	F4	May 5, 1989	1620
Cleveland, NC/Lincoln, NC/ Catawba, NC	F4	May 5, 1989	1654
Union, NC	F4	May 5, 1989	1801
Habersham, GA	F3	November 15, 1989	1830
Union, NC	F3	October 18, 1990	1500
Habersham, GA/Rabun, GA/ Oconee, SC	F3	March 27, 1994	1504
York, SC/Mecklenburg, NC	F3	March 27, 1994	
Caldwell, NC	F4	May 7, 1998	1649
Habersham, GA/Rabun, GA	EF3	April 27, 2011	2300



Fig. 14. Tornado Damage in the city of Joplin, MO. Much of the city was destroyed by an EF5 tornado on May 22, 2011. Photo courtesy of Joe Raedle, Getty Images.

you possibly can. Avoid rooms that may be damaged by falling trees.

If you are in a manufactured home, you should abandon the home in favor of a pre-determined sturdier shelter. This may be a frame home or underground shelter owned by a neighbor, or a community storm shelter. Even weak tornadoes can flip or otherwise cause significant damage to manufactured homes, especially if they are not securely tied down.

If you are caught outside, you should seek out a sturdy shelter, such as a home or office building. If shelter is not immediately available, make an attempt to drive to one. If you encounter flying debris while driving, pull over and park your vehicle. If at all possible, do not park under trees or power lines. At this point you should a.) with seat belt fastened, duck your head below the level of the windows, covering your head with your hands and a blanket OR b.) if it is obvious that you can get *below* the level of the road, abandon the vehicle and lie down in the lowest spot, making sure to cover your head.

Once you are in your shelter, find a stationary object, such as a workbench, or a sturdy piece of furniture to shelter under. If you are in a bathroom, take shelter in the tub. Cover yourself with heavy blankets, a mattress, or something similar to protect your body from flying debris. Assume the tornado protection position, taking special care to protect your head.



Fig. 16. Regardless of where you take shelter, you should assume the tornado protection position, making yourself as small a target as possible and protecting your head and face.



Fig. 15. A tornado approaches the south side of the Clemson University campus on August 26, 2008. The EF1 tornado caused minor damage in the area around Memorial Stadium just before lifting. Photo courtesy of Rob Harrison, South Carolina Dept Nat. Res.

Table 4. Killer tornadoes reported in the western Carolinas and northeast Georgia since 1950.

County	Date	Deaths	Time	Rating
Spartanburg, SC	May 10, 1952	2	1400	F3
Abbeville, SC	March 31, 1973	7	1820	F4
Greenwood, SC	December 13, 1973	2	1430	F4
Gaston, NC	April 2, 1974	1	153	F1
Graham, NC	April 3, 1974	2	2100	F2
Spartanburg, SC	May 5, 1989	2	1620	F4
Lincoln, NC	May 5, 1989	4	1654	F4
Union, NC	May 5, 1989	1	1801	F4
Chester, SC	April 16, 1994	1	111	F2
Franklin, GA	September 16, 2004	1	1645	F2
Iredell, NC	November 15, 2006	1	2345	F2
Rabun, GA	April 27, 2011	1	2300	EF3
York, SC	November 16, 2011	3	1732	EF2



Fig. 17. Even a typically weak Carolinas tornado can produce significant damage, including lifting and tossing vehicles. This photo was taken in the parking lot of Liberty Elementary School in Liberty, SC after an EF1 tornado briefly touched down on January 5, 2007. Photo courtesy of the Pickens Sentinel.

Lightning and Lightning Safety

Other than flash flooding, lightning is the most deadly weather-related phenomenon. Around 80 people are killed and hundreds injured across the United States each year due to lightning strikes. Over the past 15 years, 11 people have been killed by lightning across the western Carolinas and northeast Georgia. This is more than the number killed by tornadoes and downbursts combined.

Lightning develops as a result of updrafts and downdrafts within a thunderstorm redistributing ice and water particles throughout the cloud. The collisions between these particles cause a separation in electrical charge, with the top of the cloud becoming positively charged and the bottom of the cloud becoming negatively charged. Lightning alleviates this difference in polarity. Cloud-to-ground lightning alleviates the difference in polarity between the negatively charged cloud base and an area of positive polarity that develops on the ground beneath the storm.

Lightning heats the air around it to 50,000 °F. This rapid heating induces a shock wave that we recognize as thunder. Thunder provides us with our best defense from lightning. Basically, if you can hear thunder, you are at risk of being struck.

Lightning can strike up to 8 miles away from the storm that is causing it. This means it does NOT have to be raining where you are for you to be struck. In fact, some people are struck by lightning while the sun is shining at their location!

Georgia, North Carolina, and South Carolina all rank in the top 10 nationally in terms of lightning fatalities and injuries. One reason for this is thunderstorms are quite common across the area, especially during the late spring and summer. Another reason is the recreational opportunities that this part of the country presents. Mountains, lakes, and



Fig. 19. Lightning originating from the top of a thunderstorm can strike up to 8 miles away from the storm. Photo courtesy of Todd Lindley.



Fig. 18. Lightning typically strikes the tallest object beneath a storm. Photo courtesy of Johnny Autery.

numerous golf courses provide abundant opportunity for outdoor activities during the warm season. Unfortunately, open areas such as golf courses and lakes are frequent targets of lightning. Mountain tops are also highly vulnerable to lightning strikes, simply because they are closer to the base of thunderstorms. Lightning will always seek out the most efficient path to the ground, meaning that it usually strikes the tallest object. This may be a mountain-top, a tree, or if standing in an open area, people.

It is important to understand that the National Weather Service does not issue warnings for lightning. Remember, a severe thunderstorm is one that produces large hail and damaging winds. Lightning is not a factor in warnings, because all thunderstorms by definition produce lightning.

Key Points About Lightning Safety

- Always consult a weather forecast before participating in outdoor activities for an extended period of time, especially during the late spring and summer.
- Consider postponing activities if thunderstorm chances are high. At the very least, you should have some means of receiving timely weather reports.
- If you can hear thunder, you can be struck. Go inside.
- An enclosed structure provides the best shelter, but a hard-top automobile is adequate if other shelter is unavailable.
- If you are on a lake, get to shore immediately if you hear thunder.
- Once inside, unplug major electrical devices, stay off of corded telephones, and do not take a bath or shower.

- Do not go outside until it has been at least 30 minutes since you last heard thunder.
- If you are caught outside, seek out a low spot, such as a ditch, away from trees and other tall objects and away from anything metal. Make yourself a small target by crouching down. Cover your ears. Keep as little of your body in contact with the ground as possible by standing on your toes.



National Weather Service Watches and Warnings

The National Weather Service issues watches and warnings for hazardous weather, including severe thunderstorms and tornadoes. A watch covers a large area and means that meteorologists have determined that atmospheric conditions are favorable for a hazardous weather event. A warning covers a small area and means that meteorologists have determined that a hazardous weather event is imminent, or have received reports that the event is already occurring.

Watches are intended to heighten awareness. Once a watch is issued you should frequently monitor weather information for updates and possible warnings. Postpone outdoor activities until the threat has ended. If you cannot postpone such activities, you should at least have some way of receiving up-to-date weather information and have a plan of action if threatening weather approaches or a warning is issued for your area.

National Weather Service meteorologists use a combination of reports from weather spotters and technology such as Doppler radar and satellite data to analyze storms and make warning decisions. Once the meteorologist determines that a

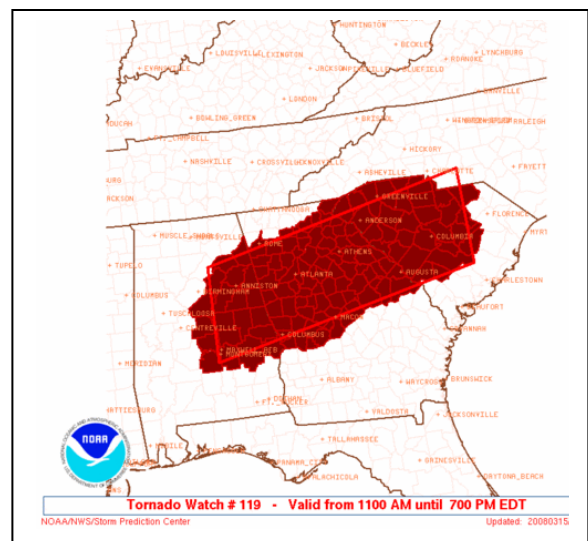


Fig. 21. Watches are issued for large areas, often covering several states. Local National Weather Service offices collaborate with the Storm Prediction Center in Norman, OK to issue watches.

storm has a high probability of producing severe weather, a warning is issued. Warnings are no longer issued for entire counties, but are issued based upon the expected track of the storm, focusing only on locations that are expected to be directly impacted by severe weather. Advances in technology resulted in a dramatic improvement in the accuracy of warnings for severe thunderstorms and tornadoes over the past 20 years.

Once a warning is issued by your local National Weather Service office, the warning is immediately disseminated by local broadcast news media. The warning is also broadcast over NOAA All-Hazards Weather Radio.

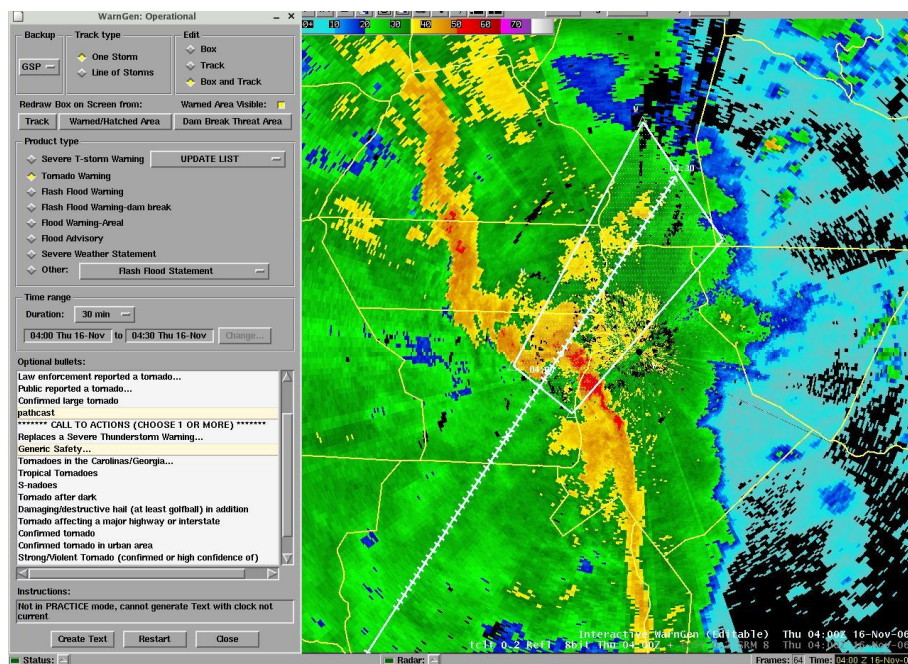
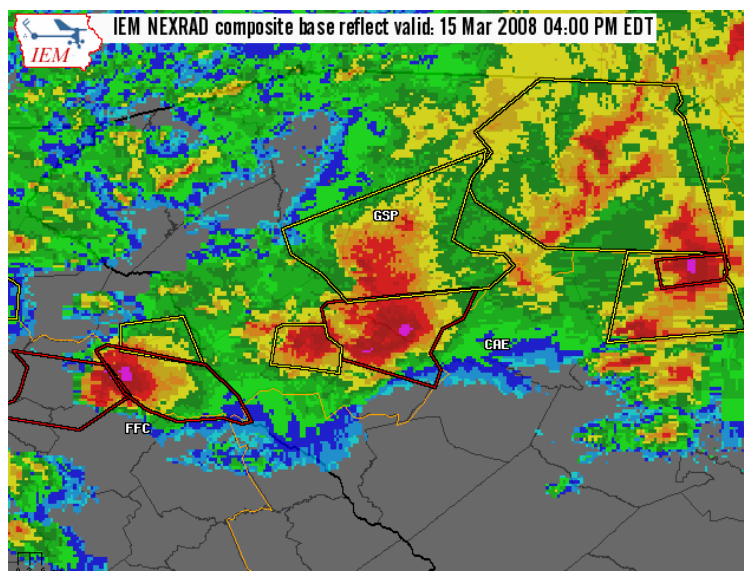


Fig. 22. National Weather Service meteorologists use computer displays such as this to analyze radar data and create and issue warnings.

Remember, the period after a warning is issued is not the appropriate time to develop a safety plan. You should already have a plan in place and be prepared to immediately act upon it once a warning is issued.

Despite improvements in technology and our scientific knowledge of severe weather, the technology and the science have limitations. We are likely many years away from having the ability to issue successful warnings for all severe weather events. For this reason, it is important that you maintain a heightened sense of awareness when a watch is issued. Keep a close eye on the weather and be prepared to act quickly in case a warning never comes.



Remember that severe thunderstorms sometimes produce tornadoes with little or no warning. This is one of numerous reasons that you should take Severe Thunderstorm Warnings seriously, especially if there is a Tornado Watch in effect.

Fig. 23. An example of National Weather Service “warning polygons.” (Bold lines represent warning outlines.) Since 2007, severe weather warnings have been storm-based, as opposed to county-based. This cuts down on the area, and therefore the number of people affected by a warning. These polygons can be viewed via local television broadcasts or on National Weather Service and other web pages. In addition, applications are becoming available to alert smart phones and other wireless devices if a device is located within the “warning polygon.” Image courtesy of Iowa Environmental Mesonet.

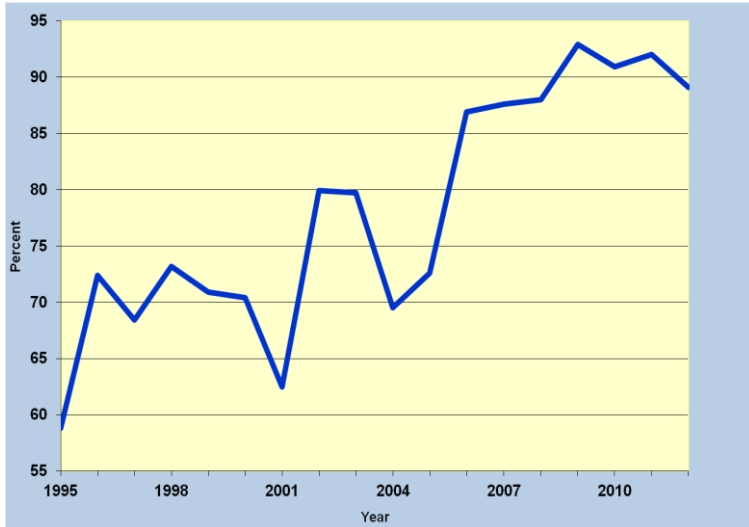


Fig. 23. A chart displaying the annual percentage of reported severe weather events that have been accompanied by National Weather Service warnings across the western Carolinas and northeast Georgia since 1990. Only 50% to 60% of events were warned in the early 90s. That number has improved to over 90% in the present day.

NOAA Weather Radio All-Hazards

Most people receive watch and warning information from broadcast media, particularly local television. This is a very effective means of receiving this critical information. However, have you ever thought about how you will receive watches and warnings if you are away from radio or television, or while you are sleeping? Unfortunately, the Carolinas have a rather high incidence of fatalities associated with tornadoes during the night. In fact, North and South Carolina rank in the top 5 nationally among states with the highest percentage of nighttime deaths due to tornadoes. These are situations in which NOAA Weather Radio All-Hazards can save lives.

Table 5. The top 5 states in percentage of killer tornadoes occurring at night. The second column is the percentage of killer tornadoes occurring at night. The third column is the percentage of all tornadoes occurring at night. Although less than 30% of all tornadoes occur at night across the Carolinas, more than half of the killer tornadoes that affect the two states occur at night. NOAA Weather Radio All-Hazards receivers can be life-savers during nighttime tornadoes. Adapted from Ashley et al., 2008.

State	Percentage of killer tornadoes occurring at night	Percentage of nighttime tornadoes
North Carolina	66.7	28.3
Tennessee	61.4	45.8
Louisiana	56.3	35.3
Arkansas	52.4	42.5
South Carolina	52.2	29.1

NOAA Weather Radio All-Hazards broadcasts weather information 24 hours a day on certain frequencies. Specially built radio devices receive these broadcasts. The most important feature of these receivers is the tone alert which allows the radio to alarm automatically as soon as a warning or watch is issued. Most of these receivers can be programmed to alarm only for certain types of watches and warnings and only for the county in which you live. Most cost less than \$100 and can be purchased in electronics stores and many discount department stores. A routine test of the NOAA Weather Radio alarm system is conducted each Wednesday between 11 am and noon.

Table 6. NOAA Weather Radio transmitters serving the Western Carolinas and Northeast Georgia.

Call Sign	Frequency	Location
WWH-24	162.425 MHz	Toccoa, GA
KXI-81	162.450 MHz	Clayton, GA
WXL-56	162.400 MHz	Asheville, NC
WXL-70	162.475 MHz	Charlotte, NC
WWG-82	162.525 MHz	Robbinsville, NC
WNG-538	162.450 MHz	Linville, NC
KYJ-85	162.525 MHz	Mooresville, NC
WXJ-21	162.550 MHz	Greenville, SC
KHC-27	162.425 MHz	Rock Hill, SC

Table 7. FIPS codes and NOAA Weather Radio transmitters for the 46 counties of the Western Carolinas and Northeast Georgia.

County	FIPS Code	Transmitter	Frequency
Elbert	13105	Athens	162.4
Elbert	13105	Kirksey, SC	162.425
Franklin	13119	Athens	162.4
Franklin	13119	Cleveland	162.525
Franklin	13119	Toccoa	162.425
Habersham	13137	Clayton	162.45
Habersham	13137	Cleveland	162.525
Habersham	13137	Toccoa	162.425
Hart	13147	Athens	162.4
Hart	13147	Cleveland	162.525
Rabun	13241	Clayton	162.45
Rabun	13241	Toccoa	162.425
Stephens	13257	Cleveland	162.525
Stephens	13257	Toccoa	162.425
Alexander	37003	Linville	162.45
Alexander	37003	Mooreville	162.525
Alexander	37003	Mount Jefferson	162.5
Avery	37011	Bristol, TN	162.55
Avery	37011	Linville	162.45
Buncombe	37021	Asheville	162.4
Burke	37023	Linville	162.45
Cabarrus	37025	Buck Mountain	162.5
Cabarrus	37025	Charlotte	162.475
Cabarrus	37025	Mooreville	162.525
Caldwell	37027	Linville	162.45
Caldwell	37027	Mount Jefferson	162.5
Catawba	37035	Charlotte	162.475
Catawba	37035	Linville	162.45
Catawba	37035	Mooreville	162.525
Cleveland	37045	Charlotte	162.475
Cleveland	37045	Rock Hill, SC	162.425
Davie	37059	Mooreville	162.525
Davie	37059	Winston-Salem	162.4
Gaston	37071	Charlotte	162.475
Gaston	37071	Mooreville	162.525
Graham	37075	Robbinsville	162.525
Haywood	37087	Asheville	162.4
Henderson	37089	Asheville	162.4
Iredell	37097	Charlotte	162.475
Iredell	37097	Mooreville	162.525
Iredell	37097	Winston-Salem	162.4
Jackson	37099	Asheville	162.4
Jackson	37099	Robbinsville	162.525
Lincoln	37109	Charlotte	162.475
Lincoln	37109	Mooreville	162.525
Macon	37113	Clayton, GA	162.45
Macon	37113	Robbinsville	162.525
Madison	37115	Asheville	162.4
Madison	37115	Bristol, TN	162.55
McDowell	37111	Asheville	162.4
McDowell	37111	Linville	162.45
Mecklenburg	37119	Charlotte	162.475
Mecklenburg	37119	Mooreville	162.525
Mecklenburg	37119	Rock Hill, SC	162.425
Mitchell	37121	Bristol, TN	162.55
Mitchell	37121	Linville	162.45
Polk	37149	Asheville	162.4
Polk	37149	Greenville, SC	162.55
Rowan	37159	Charlotte	162.475
Rowan	37159	Mooreville	162.525
Rowan	37159	Winston-Salem	162.4
Rutherford	37161	Asheville	162.4
Rutherford	37161	Greenville, SC	162.55
Rutherford	37161	Linville	162.45
Swain	37173	Robbinsville	162.525
Transylvania	37175	Asheville	162.4
Union, NC	37179	Buck Mountain	162.5
Union, NC	37179	Charlotte	162.475
Union, NC	37179	Rock Hill, SC	162.425
Yancey	37199	Asheville	162.4
Yancey	37199	Bristol, TN	162.55
Yancey	37199	Linville	162.45
Abbeville	45001	Greenville	162.55
Abbeville	45001	Kirksey	162.425
Anderson	45007	Greenville	162.55
Cherokee	45021	Charlotte, NC	162.475
Cherokee	45021	Greenville	162.55
Cherokee	45021	Rock Hill	162.425
Chester	45023	Greenville	162.55
Chester	45023	Rock Hill	162.425
Greenville	45045	Greenville	162.55
Greenwood	45047	Greenville	162.55
Greenwood	45047	Kirksey	162.425
Laurens	45059	Greenville	162.55
Laurens	45059	Kirksey	162.425
Oconee	45073	Clayton, GA	162.45
Oconee	45073	Greenville	162.55
Oconee	45073	Toccoa, GA	162.425
Pickens	45077	Greenville	162.55
Spartanburg	45083	Greenville	162.55
Union, SC	45087	Greenville	162.55
Union, SC	45087	Rock Hill	162.425
York	45091	Charlotte, NC	162.475
York	45091	Greenville	162.55
York	45091	Rock Hill	162.425

WEA, Smart Phone Apps, and Social Media

Just as the recent explosion in wireless technology and social media applications is changing the way we communicate, it is also changing the way that people are receiving warning information. While recent studies have shown that most citizens still receive weather warnings from traditional media such as television and radio, mobile phone applications and social media propagation of warning messages are becoming increasingly popular. This section highlights some of these new methods and highlights some of their strengths and weaknesses.

Wireless Emergency Alerts (WEA) are text messages of weather warnings and civil emergency messages sent as a text message to your mobile phone. Most major cell phone providers are now enabling propagation of these messages to their customers.

Strengths: (1) Immediate alert and receipt of warnings. (2) Service is free (text message charges do not apply). (3) Service is automatic. There is no need to sign up for the messages, although you can opt out by contacting your service provider. (4) The system allows you to receive warnings for your location anytime, anywhere.

Weaknesses: (1) Warning messages originate from cell towers that are located within a warning area. Any phone within range of a tower can be alerted, so some customers outside of a warning area may receive alerts. (2) Some older mobile phones may not be equipped to receive the messages. (3) These alerts are only being created for certain types of warnings.

Table 8 (Right). National Weather Service warnings that are currently being created for the Wireless Emergency Alert system.

Warning Type	WEA Message
Tsunami Warning	Tsunami Warning in this area. Avoid coastal areas. Check local media. -NWS
Tornado Warning	Tornado Warning in this area til hh:mm tzT. Take shelter now. -NWS
Extreme Wind Warning	Extreme Wind Warning this area til hh:mm tzT ddd. Take shelter. NWS
Flash Flood Warning	Flash Flood Warning this area til hh:mm tzT. Avoid flooded areas. Check local media. -NWS
Hurricane Warning	Hurricane Warning this area til hh:mm tzT ddd. Check local media and authorities. -NWS
Typhoon Warning	Typhoon Warning this area til hh:mm tzT ddd. Check local media and authorities. -NWS
Blizzard Warning	Blizzard Warning this area til hh:mm tzT ddd. Prepare. Avoid Travel. Check media. -NWS
Ice Storm Warning	Ice Storm Warning this area til hh:mm tzT ddd. Prepare. Avoid Travel. Check media. -NWS
Dust Storm Warning	Dust Storm Warning in this area til hh:mm tzT ddd. Avoid travel. Check local media. -NWS

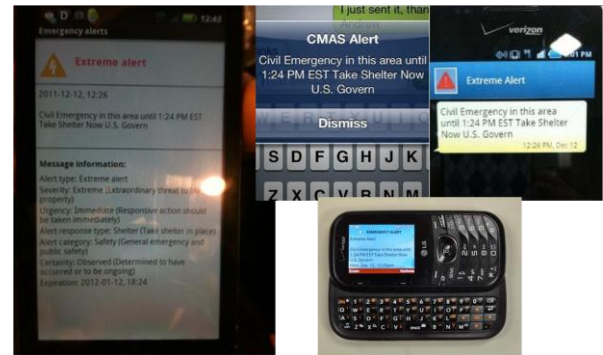


Figure 24. Examples of WEA messages from various mobile devices.



Numerous **Smart Phone Applications** have been developed by private vendors to provide weather information. Some of the most sophisticated applications make use of National Weather Service "warning polygons" and the global positioning system (GPS) functionality of smart phones such that phones will alert only when located within the boundaries of a "warning polygon."

Strengths: (1) Immediate alert and receipt of warnings. (2) Most applications can be configured to be alerted for as many or as few advisories, watches, and

Figure 25. Example of a warning alert from a smart phone application utilizing National Weather Service "warning polygons" along with the smart phone's GPS functionality. This particular application alerts only if the phone is located within the "warning polygon," illustrated by the black box on the display screen at the lower right.

warnings as the user wants. (3) The more sophisticated applications are location-specific. Your phone will only be alerted if/when a warning is in effect for your exact location.

Weaknesses: (1) Due to the volume of applications, choosing the one that's best for your needs can be challenging. (2) The more sophisticated applications can cost \$10–\$20.

Finally, the National Weather Service is making increasing use of **Social Media** technology, not only to “get the word out” about warnings and other critical weather information, but also to collect reports of severe weather and other vital information that meteorologists use in their warning decision making process. Although the NWS does automatically post warnings to Facebook, we discourage the use of this tool as a primary means of receiving warnings. Twitter is used by the NWS to disseminate environmental information and promote weather awareness activities. However, social media allows you the customer to become an important component of the warning process. By “retweeting” or “liking” Facebook postings of NWS warnings and/or severe weather reports, our message can propagate quickly to your subscribers who may not have other means of receiving warnings. Additionally, Facebook posting or tweeting your observations of hail, wind damage, and flooding to the National Weather Service may be of vital importance to forecasters making warning decisions.

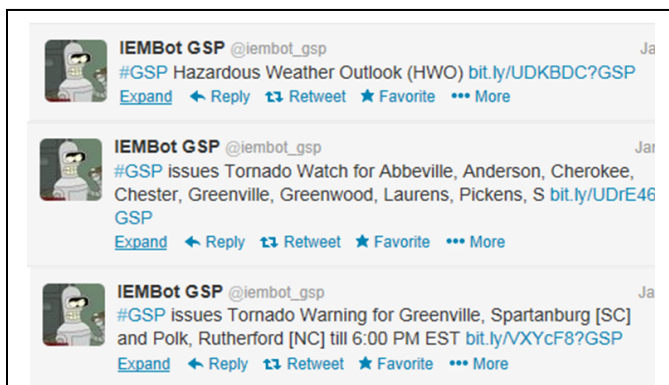


Figure 27. Example “tweets” of National Weather Service outlook, watch, and warnings. Your “retweeting” these messages can help us get our message out.

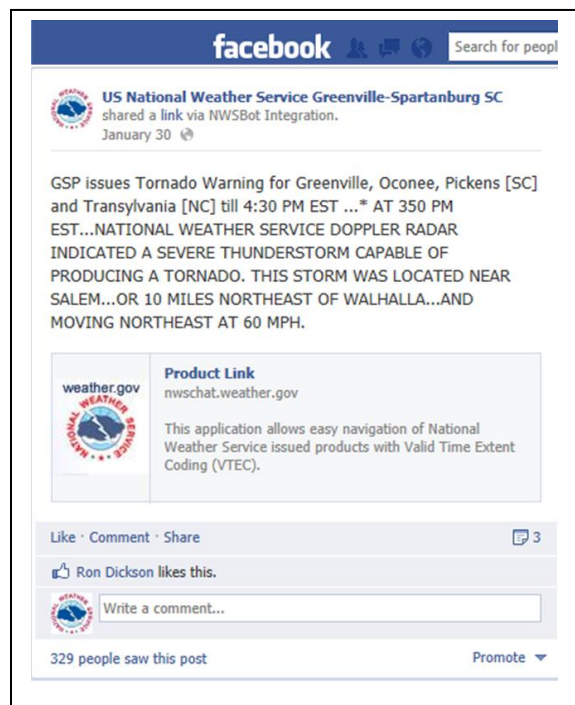


Figure 26. Example Facebook posting of a National Weather Service Tornado Warning. Your “liking” or “sharing” these posts can assist us in getting our message out. Facebook is also a good way of sending reports to the NWS. Your reports are very important.

Find us on Facebook at <http://www.facebook.com/US.NationalWeatherService.GSP.gov>

us using #NWSGSP.

You can also call in severe weather reports at 1-800-267-8101.

National Weather Service
Weather Forecast Office Greenville-Spartanburg
GSP International Airport
1549 GSP Drive
Greer, SC 29651

Please send any comments or questions to
justin.lane@noaa.gov.

"The National Weather Service (NWS) provides weather, hydrologic, and climate forecasts and warnings for the United States, its territories, adjacent waters and ocean areas, for the protection of life and property and the enhancement of the national economy. NWS data and products form a national information database and infrastructure which can be used by other governmental agencies, the private sector, the public, and the global community. "

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